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RESEARCH

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Corantes alimentares presentes em alimentos ultraprocessados consumidos por universitários

Food dyes present in ultra-processed foods consumed by university students

Colorantes alimentarios presentes en alimentos ultraprocessados consumidos por universitários

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ABSTRACT

Objective: To describe the food dyes present in ultra-processed foods consumed by 273 students of the Nutrition Course at a public university of Rio de Janeiro. **Methods:** It was characterized the socio-demographic and health profile using semi-structured questionnaire. Consumption of ultra-processed food was conducted by the Food Frequency Questionnaire (gelatin, stuffed cookies, candies and bubble gum, soda, prepared solid to refreshment drink, industrialized juice, bouillon cube and instant noodles), and the food dyes were identified in the products' label. **Results:** The consumption of products containing food dyes such as gelatins, candies and bubble gum, soda, and bouillon cube was above 80%. The candy and bubble gum, and bouillon cube consumption were almost daily, being 56.9% and 54.1% respectively. **Conclusion:** 14 food dyes were identified on the labels of ultra-processed food. The artificial dyes caramel III and IV, S bourdeaux, sunset yellow and tartrazine, and the natural colorants annatto and carmine were highlighted.

Descriptors: Food dyes; food habits; risk.

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RESUMO

Objetivo: Descrever os corantes alimentares presentes nos alimentos ultraprocessados consumidos por 273 graduandos de uma universidade pública do Rio de Janeiro. **Métodos:** Foi caracterizado o perfil sociodemográfico e de saúde a partir de questionário semiestruturado. Consumo de alimentos ultraprocessados foi obtido através do Questionário de Frequência Alimentar (gelatinas, biscoitos recheados, balas e chicletes, refrigerantes, preparados sólidos para refresco, sucos industrializados, temperos prontos e macarrão instantâneo) e os corantes foram identificados nos rótulos dos produtos. **Resultados:** O consumo de produtos contendo corantes como gelatinas, balas e chicletes, refrigerantes e sucos industrializados foi acima de 80%. Balas e chicletes e temperos prontos tiveram consumo quase diário, sendo 56,9% e 54,1% respectivamente. **Conclusão:** Identificaram-se quatorze corantes nos rótulos dos produtos industrializados ultraprocessados. Destacaram-se os corantes artificiais caramelos III e IV, bordeuax S, amarelo crepúsculo e tartrazina, e naturais urucum e carmim.

Descritores: Corantes de alimentos; hábitos alimentares; risco.

RESUMEN

Objetivo: Describir los colorantes alimenticios presentes en los alimentos ultra-procesados consumidos por 273 estudiantes de una universidad pública de Río de Janeiro. **Métodos:** Fue caracterizado el perfil sociodemográfico y de salud, a partir de cuestionario semiestructurado. Consumo de alimentos ultra-procesados, fue obtenido a través del Cuestionario de Frecuencia Alimentar (gelatinas, galletas rellenas, caramelos y chicles, refrescos, preparados sólidos para refresco, jugos industrializados, condimentos preparados y pastas instantáneas) y los colorantes fueron identificados en las etiquetas de los productos. **Resultados:** El consumo de productos conteniendo colorantes como gelatinas, caramelos y chicles, refrescos y jugos industrializados fue superior al 80%. Caramelos, chicles y condimentos preparados tuvieron consumo casi diario, 56,9% y 54,1% respectivamente. **Conclusión:** Se identificaron catorce colorantes en las etiquetas de los productos industrializados ultra-procesados. Los colorantes artificiales caramelos III y IV, bordeuax S, amarillo crepúsculo y tartracina, y naturales urucum y carmim se destacaron.

Descriptores: Colorantes de alimentos, hábitos alimenticios, riesgo.

INTRODUCTION

The dietary pattern of the population has undergone changes in recent years, in which the increase in the consumption of processed products associated with physical inactivity increases the risk of chronic diseases. Freedom of choice of food in adolescence, in which are usually consumed cookies, soft drinks, fast foods, processed products ready for consumption and low intake of fruits and vegetables, contribute to unhealthy eating habits that generally persist into adulthood.¹

For many, starting higher education means that for the first time, the young have to be responsible for housing, food and finance, together with the university social life, leading it to prefer fast food and easy access preparation, omissions meals, in addition to physical inactivity, smoking and alcohol consumption.²⁻³

Products such as candies, chocolates and biscuits are consumed due to the little time devoted to meals. Moreover, in times of stress, some students use food as a way to escape anxiety.⁴ The instant noodles and frozen food are common at this stage due to the inability to prepare meals. Thus, the foods commonly consumed by college students are mostly ultra-processed industrial products ready for consumption.⁵ In the manufacture of these products various food additives that aims to increase the shelf life and better acceptance of them by the consumer, either through color or taste, are used.

Food additive aims to modify the physical, chemical, biological or sensory characterizes during manufacture, processing, preparation, treatment, packaging, wrapping, storage, transport or handling of a food. The use of additives can be justified when it has advantages from a technological point of view, sanitary toilet or if such an advantage cannot be achieved during manufacture which does not exceed the limit of the Acceptable Daily Intake (ADI).⁶

This limit is established by the experts of the United Nations Food Additives Food and Agriculture Committee (FAO) / World Health Organization (WHO) [The Joint FAO / WHO Expert Committee on Food Additives - JECFA]. ADI is estimated by toxicological studies, in which it is established the maximum amount of food additive that the individual can ingest daily without it bring health risk. It is expressed in milligrams per kilogram of body weight (mg/kg/bw).⁷

It is known that color can influence the decision to choose food or rejection of it. Colorant can be defined as “a substance that confers or enhances restore the color of a food”.^{6,4}

Studies have shown that dyes can cause adverse health effects, such as food hypersensitivity, some types of cancer, hyperactivity Disorder, Hyperactivity Attention Deficit (ADHD), among others.⁸⁻⁹

Although the dye is capable of causing adverse health effects, they are large-scale additives used by the food industry.^{7,10-11}

Given the above, this study aims to describe the food dyes present in the ultra-processed foods consumed by college of nutrition course at a public university of Rio de Janeiro.

METHOD

This is a cross-sectional study with a sample of 273 students at a public university located in the city of Rio de Janeiro, held in the period from 2010 to 2015. As inclusion criteria graduating students should be enrolled in the first or second semester of Nutrition course, and the participation in the research was by signing the Informed Consent and Informed (WIC).

To data collection, we used a self-administered semi-structured questionnaire covering socio-demographic and health information, the following variables were selected: age, gender, family income, and family history of chronic noncommunicable diseases.

With regard to dietary intake information, it was collected through the Food Frequency Questionnaire (FFQ) related to industrial products (gelatin, soda, sandwich cookies, solid preparations for refreshment ready spices, candies and chewing gum, instant noodles and industrialized juice), brand, flavor and frequency of use. To highlight the dyes present in the manufactured products, the labels of which were observed. The variables are presented descriptively by simple frequency. For products that graduate students could not tell the brand, it was located through the fancy name and/or taste cited by them.

For data entry was used Microsoft Office 2013 program (Word and Excel). Data analysis (basic statistics) was performed using SPSS software version 13.

Such research was submitted to the Research Ethics Committee - CEP - UNIRIO - Federal University of the State of Rio de Janeiro, and approved CAAE (0001.0.313.000-10) on 28/01/10, meeting the standards of the National Ethics Council search.

RESULTS AND DISCUSSION

Featuring the socio-demographic and health profile of the population studied, the majority was aged between 17 and 21 years (83.5%), predominantly females with 91.6%. Just as in a study of 122 students of nutrition, 94.3% were female and aged between 18 and 28 years.¹² In relation to household income, 30% had an income of 4-6 minimum wages, 23.1% gain from 7 to 10 minimum wages, 17.2% earn more than 10 minimum wages, 15.8% earn less than three minimum wages and 13.9% did not report.

Chronic non-communicable diseases related to family history that stood out were systemic arterial hypertension (23.9%), followed by diabetes mellitus (17.1%) and cancer (14.1%). Allergy was cited by 17.5% of respondents.

With regard to the consumption of processed products, gelatin was consumed by 81% of the students. More than half of these students rarely consume it (62.4%), 21.3% consumes in 15 to 15 days, 11.3% of one to two times a week, and 4.1% 3-5 times a week. The most cited was the strawberry flavor (44.9%), followed by grape (11.9%) and raspberry (11.4%). In addition, 23.8% reported consuming various flavors.

Stuffed cookies were consumed by 83.5% of respondents, in which 36.8% of them consume the biscuit rarely, 21.5% 1-2 times a week, 20.2% 3-5 times 15, 8% every 15 days and 5.7% daily. It was preferred flavors chocolate with 66.4%, strawberry with 20.1%, and 13.4% other.

Candies and chewing gum were consumed by 90.8% of the students, in which the frequency of use was 29% to 3 to 5 times a week, daily for 27.8%, from 1 to 2 times a week for 21%, seldom for 13.7% and 15 to 15 days at 8.5%. Noteworthy are the mint and strawberry flavors with 18.8% and 12.8%, respectively. 18.1% chocolate, 50.3% said they consume several flavors.

In figure 1 are shown the products consumed highlighting flavor, dye type, amount of dye in 100g of the product and the recommended daily intake (ADI).

Figure 1. Flavor, dyes present, amount of dye in mg/100g of the finished product and the Acceptable Daily Intake (ADI) permitted by ANVISA, found in jelly, stuffed cookie and candies and chewing gum consumed by Nutrition graduate students of a public university Rio de Janeiro - RJ

Favor	Dye	mg/100g of product	ADI (mg/kg/bw)
Gelatin			
Strawberry	Bordeaux S	10	0 - 0.5
	Sunset yellow	10	0 - 4
Grape	Bordeaux S	10	0 - 0.5
	Brilliant Blue	15	0 - 12.5
	Tartrazine	15	0 - 7.5
raspberry	Bordeaux S	10	0 - 0.5
	Sunset yellow	10	0 - 4
Stuffed cookies			
Chocolate	Caramel III	<i>quantum satis</i>	0 - 160
Strawberry	Carmine	30	0 - 5
Candies / chewing gum			
Mint	Tartrazine	30	0 - 7.5
	Brilliant Blue	30	0 - 12.5
	Titanium dioxide	<i>quantum satis</i>	not limited
Strawberry	Red 40	30	0 - 7.0
	Beet red	<i>quantum satis</i>	not limited
	Carmine	30	0 - 5
	Paprika	<i>quantum satis</i>	0 - 1.5

Source: Resolution No. 388, August 5 1999;¹³ Resolution No. 383, August 5 1999;¹⁴ Resolution No. 387, August 5 1999.¹⁵

In relation to sodas, it was consumed by 81%, 33.9% reported in which consume 1 to 2 times per week, rarely 30.3%, 14.9% 3 to 5 times a week, 10.4 % daily and 10.4% for 15 to 15 days. The flavors that most pleased students were Cola (52.2%) and Guarana (33.2), other flavors were chosen by 14.7% of the same.

The solid preparations for refreshment drinks was consumed by 44.3% of students, and rarely consume 43.8%, 22.3% 3 to 5 times per week, biweekly 14%, 12.4% 1 to 2 times per week and 7.4% daily. The preferred flavors are orange (17.3%), passion fruit (14.7%), and grape (13.3%). 24% prefer other flavors and 30.7% drank several flavors.

Regarding industrialized juices, it was consumed by 82.4% of students. The juices were consumed 3 to 5 times a week for 23.6% of the students, 1 to 2 times a week by 23.6%, 22.2% daily, rarely by 21.8% and 15 to 15 days per 8.9%. Among the preferred flavors are: passionfruit (26%), grape (20%), peach (10.7%) and mango (10%). 26.0% preferred other flavors and 7.3%, various flavors.

In Figure 2 it was highlighted the products consumed highlighting flavor, dye type, amount of dye in 100g of the product and the recommended daily intake (ADI).

Figure 2 - Taste, dyes present, amount of dye in mg/100g of the finished product and the Acceptable Daily Intake (ADI) permitted by ANVISA, found in solid preparations for refreshment and industrialized juices consumed by Nutrition graduate students of a public university Rio de Janeiro - RJ

Flavor	Dye	mg/100g of the product	ADI (mg/kg/bw)
Soda			
Cola	Caramel IV	<i>quantum satis</i>	0 - 200
Guarana	Caramel IV	<i>quantum satis</i>	0 - 200
Solid preparations for refreshment drinks			
Orange	Tartrazine	10	0 - 7.5
	Sunset yellow	10	0 - 4
	Titanium dioxide	<i>quantum satis</i>	not limited
Grape	Red 40	10	0 - 7
	Bordeaux S	5	0 - 0.5
	Brilliant Blue	10	0 - 10
	Titanium dioxide	<i>quantum satis</i>	not limited
Passionfruit	Caramel IV	<i>quantum satis</i>	0 - 200
	Tartrazine	10	0 - 7.5
	Sunset yellow	10	0 - 4
	Titanium dioxide	<i>quantum satis</i>	not limited
Industrialized juice			
Passionfruit	Annatto	5	0 - 3
	Beta Carotene synthetic identical to natural	<i>quantum satis</i>	0 - 0.5
Grape	Carmine	10	0 - 5
	Annatto	5	0 - 3
	Carmine	10	0 - 5
Peach	Beta Carotene synthetic identical to natural	<i>quantum satis</i>	0 - 0.5
Mango	Annatto	5	0 - 3
	Beta Carotene synthetic identical to natural	<i>quantum satis</i>	0 - 0.5

Source: RDC No. 5, January 15, 2007.¹⁶

Seasonings ready to use were consumed by 66.3% of the students, and reported use: daily (32.6%), rarely (23.2%), 3 to 5 times per week (21.5%), 1 to 2 times week (12.2%) and 10.5% every 15 days. The most cited flavors were chicken and

beef with 37.3% and 33.7%, respectively. 18.1% consumed several flavors and 10% others.

He consumption of instant noodles was 70%, the frequency for rarely is (52.5%), for 15 in 15 days (25%), 1 to 2 times a week (13.5%), 3 to 5 times weekly (8.0%) and daily (1.0%). The favorite flavors were chicken (44.0%) and meat (29%). 14.0% consumed several flavors and 13.0% others.

Figure 3 shows the products consumed highlighting flavor, dye type, amount of dye in 100g of the product and the recommended daily intake (ADI).

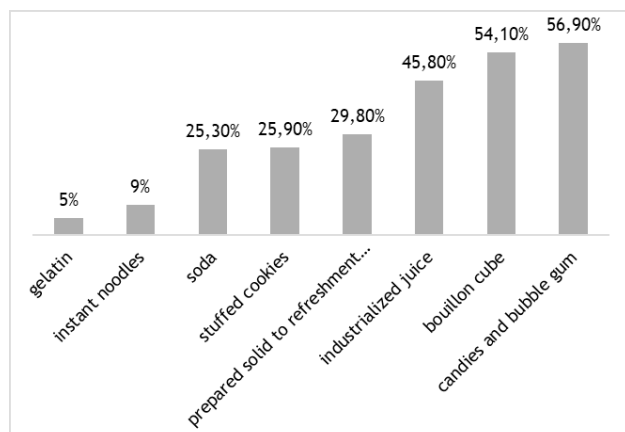
Figure 3 - Flavor, dyes present, amount of dye in mg/100g of the finished product and the Acceptable Daily Intake (ADI) permitted by ANVISA, found in ready seasonings and instant noodles consumed by undergraduate nutrition student of a public university of Rio de Janeiro, RJ

Flavor	Dye	mg/100g of the product	ADI (mg/kg/bw)
Seasonings ready			
Chicken	Caramel III	<i>quantum satis</i>	0 - 160
	Caramel IV	<i>quantum satis</i>	0 - 200
Beef	Caramel III	<i>quantum satis</i>	0 - 160
	Caramel IV	<i>quantum satis</i>	0 - 200
	Annatto	15	0 - 12
instant noodles			
pasta	Beta Carotene synthetic identical to natural	<i>quantum satis</i>	0 - 0.5
Beef (seasoning)	Caramel III	<i>quantum satis</i>	0 - 160
	Caramel IV	10	0 - 200
		50	
Chicken (seasoning)	Caramel IV	<i>quantum satis</i>	0 - 200
	Annatto	10	0 - 12
	Turmeric	50	0 - 3

Source: RDC Resolution No. 33 of 9 March 2001¹⁷; RDC No. 60 of 05 September 2007¹⁸; RDC No. 4 of 15 January 2007.¹⁹

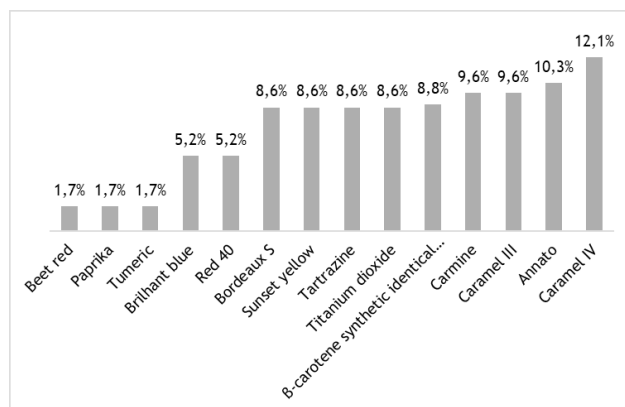
Considering the possible occurrence of health risks due to the amount and duration of exposure to dyes, it performed the sum of daily frequencies and 3-5 times a week (Figure 4) to identify products consumed more often by graduate students.

Figure 4 - Frequency of the sum of daily consumption and 3 to 5 times a week of food products consumed by university nutrition students at a public university of Rio de Janeiro



In Figure 5 we highlighted the frequency of dyes found on the labels of ultra-processed products under the brands most consumed by the university students. Some products have more than one favorite brand. Thus, the number of brands of products were gelatin (1), soda (2), filled biscuit (2) prepared solid to refreshment drink (1) ready seasoning (2), candy / gum (3), instant noodles (1) and processed juices (2).

Figure 5 - Frequency of dyes in products consumed by the university students of Nutrition of a public university of Rio de Janeiro



Evaluated ultra-processed products are predominantly consumed by adolescents, and this eating habit lingers among university students. Among the food, gelatin, soda, stuffed cookie, candy and chewing gum and industrialized juices stood out among undergraduate nutrition students, and candy, chewing gum and ready seasonings had increased consumption in the frequency daily or 3-5 times a week. In the analysis of the labels we found that the most commonly found in products consumed dyes were caramel IV, annatto, caramel III and carmine.

A study analyzed candies, treats, chewing gum, chocolate and confectionery cereals, and found that, of twenty-seven chewing gum samples, nine were dyes above recommended. In two samples of chocolate confectionery four dyes were

found.²⁰ Also in our study it was observed that the solid preparations for Refreshment of that brand were four dyes, being in disagreement with the Brazilian legislation which allows the use in maximum of three dyes.²¹

The presence of dyes above recommended by Brazilian legislation of ultra-processed industrialized products samples demonstrates consumer vulnerability, because the higher the amount of dye in the product, the greater the risk of adverse health effects.⁷

The caramel IV dye was what stood out the products consumed by university students (13.5%). Studies have shown that the caramel IV may be associated with cancer of lung, liver, thyroid, and leukemia due to a substance called 4-methylimidazole, present in caramel IV. During the IV caramel manufacturing process various unwanted substances are formed, among which imidazole, which generates the by-product 4-methylimidazole, which is the carcinogen.²²⁻²³⁻²⁴

ANVISA keeps the caramel IV in Brazilian health legislation based on the JECFA studies (Committee on Food Additives Experts - FAO / WHO), which determined that the caramel color IV ADI is 200 mg/kg/bw, and the acceptable limit is 4-methylimidazole to 250 mg/kg of the dye and there is no evidence suggests that consumption of foods containing caramel IV causes adverse health effects.²⁵⁻²⁶

The Annatto was another dye present in products consumed by respondents. The same can result in urticaria in some patients with hypersensitivity, and anaphylaxis, urticaria and angioedema.^{11,27}

In a case study with a 47 year old woman that had asthma, allergic rhinitis and syndrome of oral allergy, it was concluded that these adverse effects emerged after patient contact with the dye carmine on 3 products - yogurt, red tortellini and makeup - and also ingested drug containing the dye, which was later replaced with one that had not carmine in its composition.²⁸

The dye Bordeaux S, also known as amaranth, is part of a group of dyes in their degradation can release toxic compounds, indicating carcinogenic action. Although it is not yet proven this adverse effect, the use of dye was banned in the United States, Russia, Canada, Norway.²⁹ In our study, the Bordeaux S was one of the dyes that stood out in the products consumed by the university students.

In a study to investigate the effects of sunset yellow, amaranth and tartrazine dyes in the intestine, it was used two doses of the dye in mice. They concluded that acute exposure is not genotoxic, but has seen a significant amount of metabolites of dyes in colonic cells.³⁰

Analyzing the concentration of tartrazine in pineapple jelly, prepared solid to refreshment and isotonic orange flavor, with nine samples of each product of different brands, the authors saw that the gelatin and solid preparations had exceeded the allowed limit of tartrazine.³¹

Divided into 9 groups, 54 rats were used in an experimental study to determine changes in the immune

system, liver and kidney after consuming artificially colored foods (artificially colored fruit juice, potato chips flavored ketchup, chocolate and candy colored synthetic). After administration of juices, urticaria was noted after 13 weeks and the animals were more aggressive.³²

Considering the consumption of ultra-processed foods, a study of undergraduate students of Nutrition and Nursing found the consumption of gelatin was 73.2%, while soda was 82.2%, close to the results found in this study.³³

In another study with eleven courses at the National University of Colombia, Bogotá, there was a daily consumption of 85.9% sugar and 85.9% of sweet (35.36). Many of the food consumed by university students showed in their composition sucrose, which draws our attention to the risk of other chronic diseases such as obesity and diabetes, and the presence of dyes that can trigger allergies and cancer, especially when the intake Acceptable daily (ADI) is exceeded.³⁴

Evaluating eating habits of health of university students, found 74% of inadequacy in the consumption of soft drinks and sweets.³⁵ Other authors reported that 51.1% of students at a public university in the Northeast consumed fried foods, sausages or sweets properly.³⁶ In this study it was found that the consumption of soda was 81% among university students, and the frequency of 3 to 5 times a week and daily was 14.9% and 10.4%, respectively.

Comparing the Family Budget Survey (POF) 2002-2003 and 2008-2009 held in Brazil, it was observed that the consumption of cookies, soda and ready meals are increasing over the years, as the higher the income, the higher the consumption ultra-processed products.³⁷

Intending to encourage adherence of the population to practice healthy eating, the Ministry of Health reshaped the food guide for the Brazilian population promoting social food system and environmentally sustainable, avoiding fast food chains, ultra-processed foods due to the high level of sodium, fat, simple carbohydrates and food additives.⁵

Chronic non-communicable diseases (NCDs) such as diabetes, obesity, cardiovascular diseases and cancer are related to improper eating habits, physical inactivity, smoking and alcoholic drinks consumed in excess.^{35,38} In this study, hypertension, diabetes mellitus and cancer were the NCD most cited by university students.

In view of the above facts, it is still a major challenge for public health to reduce the consumption of ultra-processed foods in food additives. Even when dealing with university students in the area of nutrition, they follow the trend of the general population, in which the consumption of ultra-processed processed foods is growing every year. Measures are needed most encouraging healthy eating habits and physical activity among university students, they are the ones who will provide information to the public about healthy eating habits.

CONCLUSION

Fourteen dyes were found on the labels of the products consumed.

The consumption of ultra-processed foods was high among the graduate students and the dyes that stood out were the artificial coloring caramel III and IV, Bordeaux S, sunset yellow and tartrazine, and natural dye annatto and carmine.

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